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The effects of the dietary supplementation of *Echinacea purpurea* extract and/or vitamin C on the intestinal histomorphology, phagocytic activity, and gene expression of the Nile tilapia

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ABSTRACT

In this study, the influence of the dietary incorporation of *Echinacea purpurea* (EP) extract and/or vitamin C on the intestinal histomorphology and some immunological indices were tested in the Nile tilapia (*Oreochromis niloticus* Linn.). *O. niloticus* were randomly divided into four groups. The control group G_1 was fed on a basal diet, while the G_2 and G_3 were fed on basal diets, supplemented with EP extract and vitamin C at the doses of 500 mg kg^{-1} and 400 mg kg^{-1}, respectively. Meanwhile, G_4 was fed on a basal diet, supplemented with a mixture of EP extract and vitamin C. After 28 days of feeding, the intestinal tissues were collected for histological observation and immune status, based on an assay for measuring the phagocytic activity. Furthermore, the expression of the transforming growth factor-beta 1 (TGF-β1), interleukin-11beta (IL-1β), and tumor necrosis factor alpha (TNF-α) genes was evaluated in intestine and head kidney. The results revealed that the G_4 successfully surpassed the other groups in terms of the heights of intestinal villi, the number of goblet cells and intraepithelial lymphocytes (IELs), and the phagocytic activity, followed by the G_3 and G_2. The expression of the IL-1β and TNF-α genes were up regulated only in G_4 but in the G_3 only the expression of the IL-1β gene was up regulated. Hence, EP extract along with vitamin C could be used as a feed additive